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Greenfield et al.

(10) **Patent No.: US 9,091,422 B2**
(45) **Date of Patent: Jul. 28, 2015**

(54) **LED LIGHTING ELEMENT**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **13/035,626**

(22) Filed: **Feb. 25, 2011**

(65) **Prior Publication Data**

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Related U.S. Application Data

(60) Provisional application No. 61/308,171, filed on Feb. 25, 2010, provisional application No. 61/345,378, filed on May 17, 2010.

(51) **Int. Cl.**
B60Q 1/06 (2006.01)
F21V 23/02 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC ***F21V 23/02*** (2013.01); ***F21S 4/008*** (2013.01); ***F21V 3/00*** (2013.01); ***F21V 15/01*** (2013.01);
(Continued)

(58) **Field of Classification Search**
CPC F21S 4/008; F21V 15/01; F21V 17/164; F21V 15/013
USPC 362/373, 294, 370, 800, 234, 240
See application file for complete search history.

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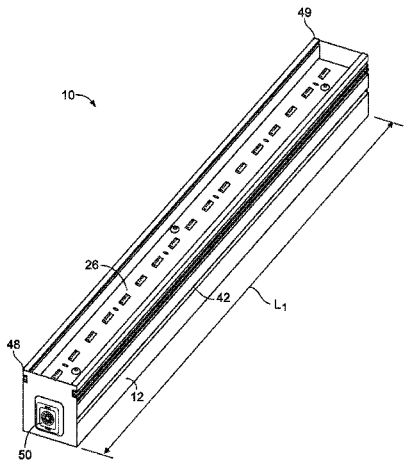
(57) **ABSTRACT**

An LED lighting element having an H-shaped housing. The housing, which may be an extruded housing, has a first section and a second section which is separated from the first section by a cross bar. A back plate is positioned opposite of the crossbar and is removably secured to the first section. A heat sink is located within the housing while a microcontroller and LED drive/control technology and integrated power supply contacts the heat sink and is attached to the back plate. An LED PC board that is electrically connected to the microcontroller and LED drive/control technology and integrated power supply is positioned in the second section and is attached to the housing. An end cap for the housing along with a method for constructing the lighting element are also disclosed.

33 Claims, 20 Drawing Sheets



(51) **Int. Cl.**

F21S 4/00	(2006.01)
F21V 3/00	(2015.01)
F21V 15/01	(2006.01)
F21V 15/015	(2006.01)
F21V 17/16	(2006.01)
F21V 21/02	(2006.01)
F21V 27/00	(2006.01)
F21V 29/00	(2015.01)
F21W 101/06	(2006.01)
F21W 101/08	(2006.01)
F21Y 101/02	(2006.01)
F21Y 103/00	(2006.01)

(52) **U.S. Cl.**

CPC ***F21V 15/013*** (2013.01); ***F21V 15/015*** (2013.01); ***F21V 17/164*** (2013.01); ***F21V 21/02*** (2013.01); ***F21V 27/00*** (2013.01); ***F21V 29/004*** (2013.01); *F21W 2101/06* (2013.01); *F21W 2101/08* (2013.01); *F21Y 2101/02* (2013.01); *F21Y 2103/003* (2013.01); *Y10T 29/49117* (2015.01)

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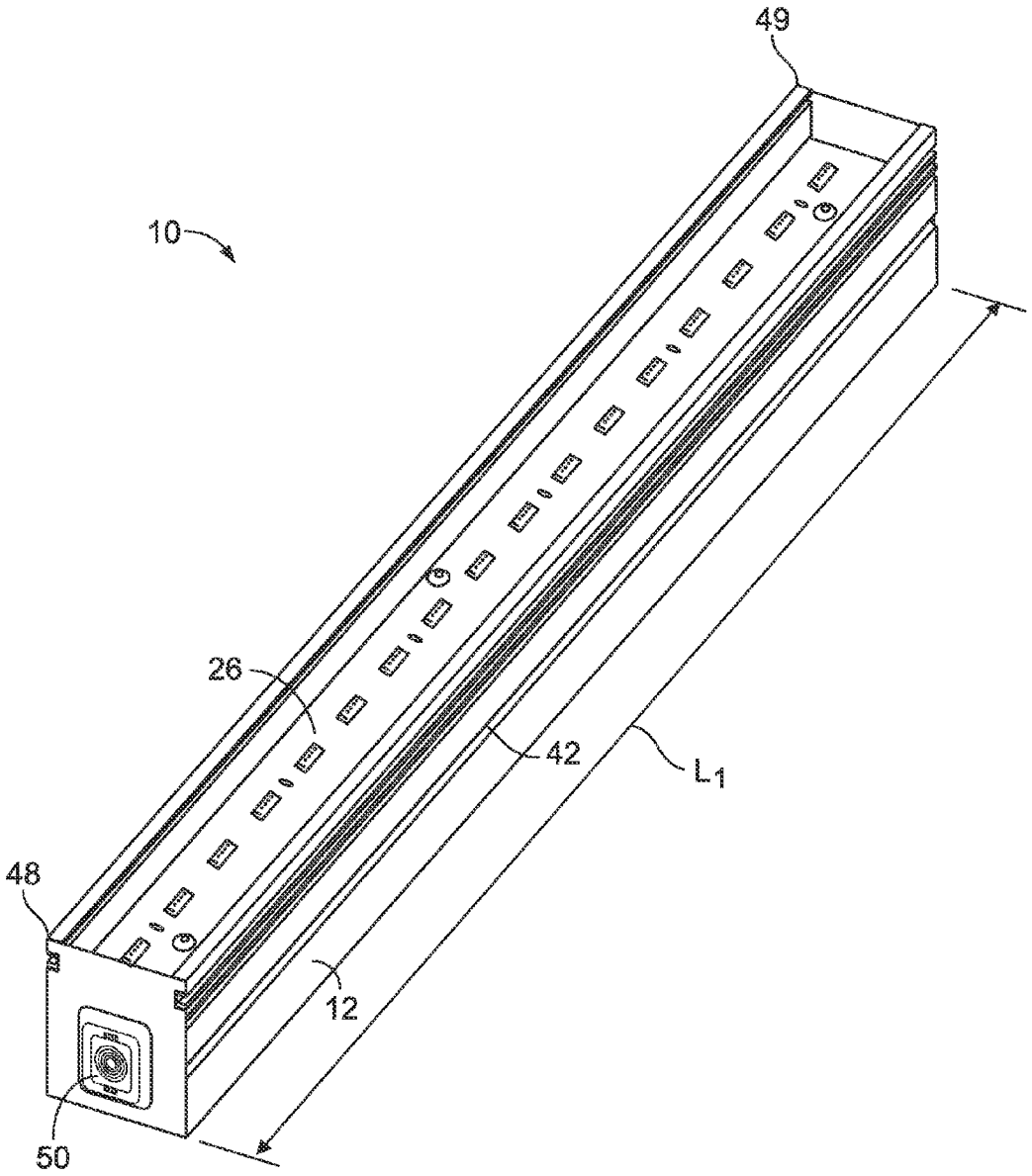

FIG. 1

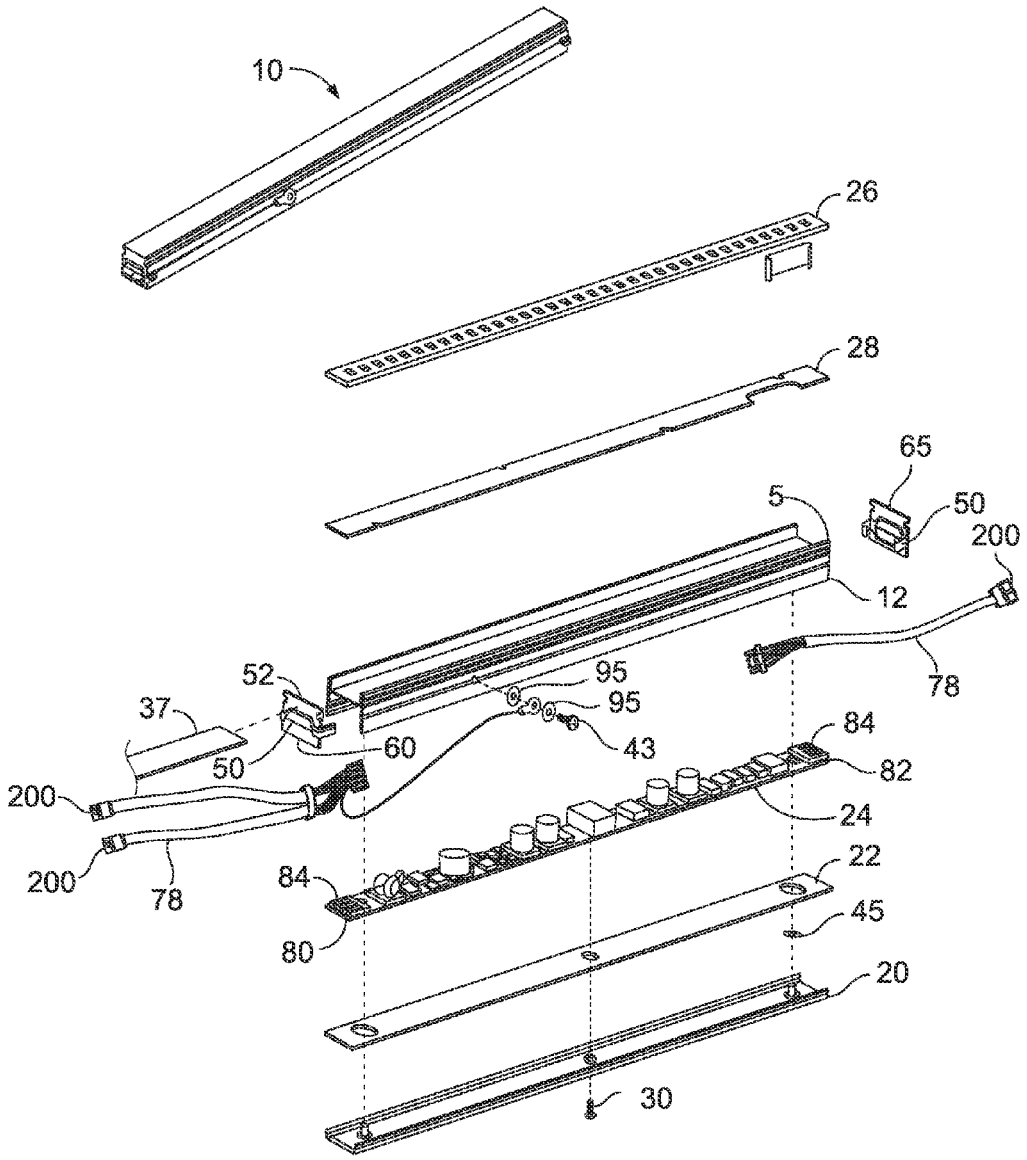
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FIG. 2

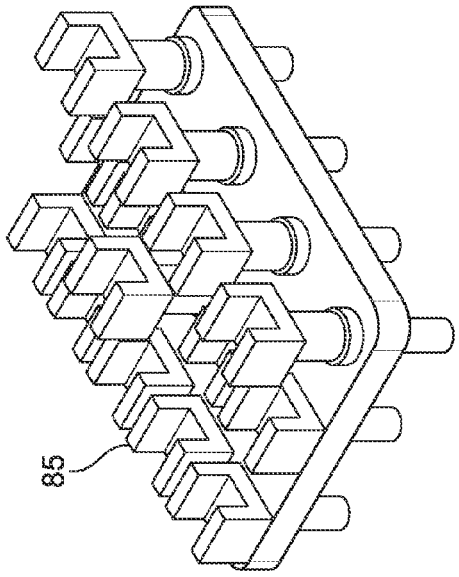

FIG. 2A

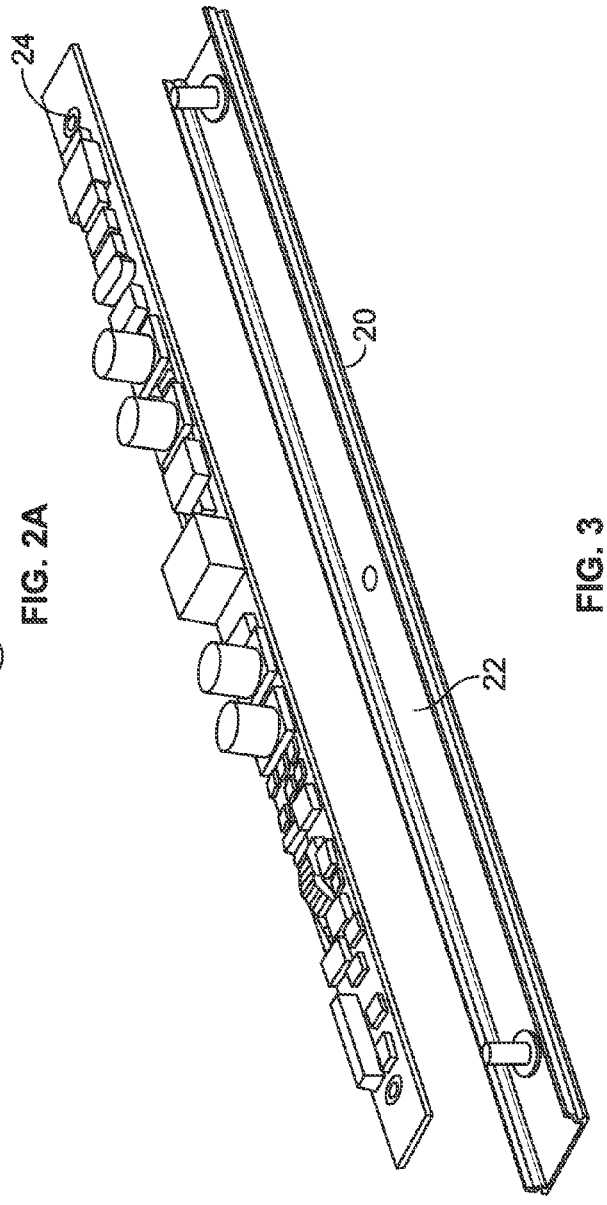

FIG. 3

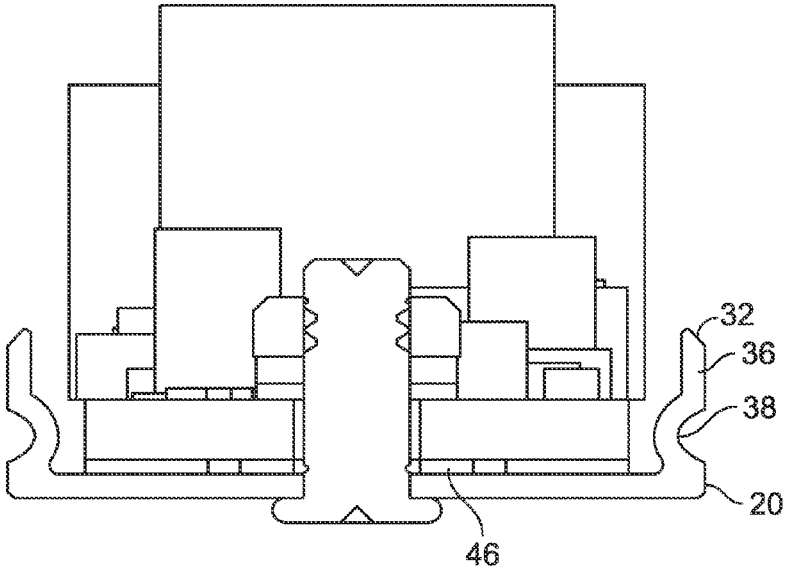

FIG. 4

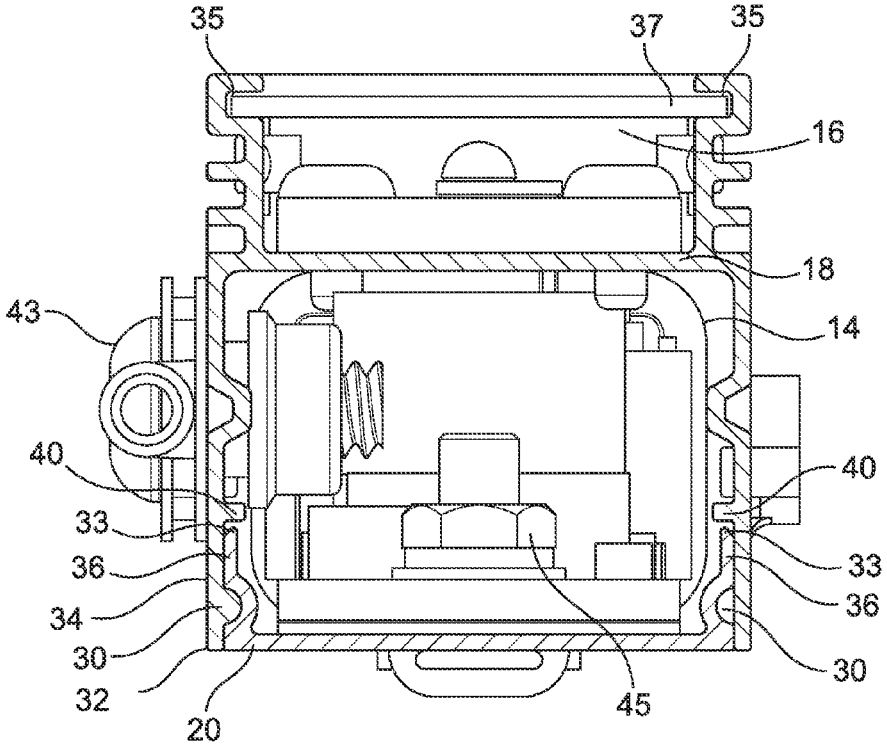

FIG. 4A

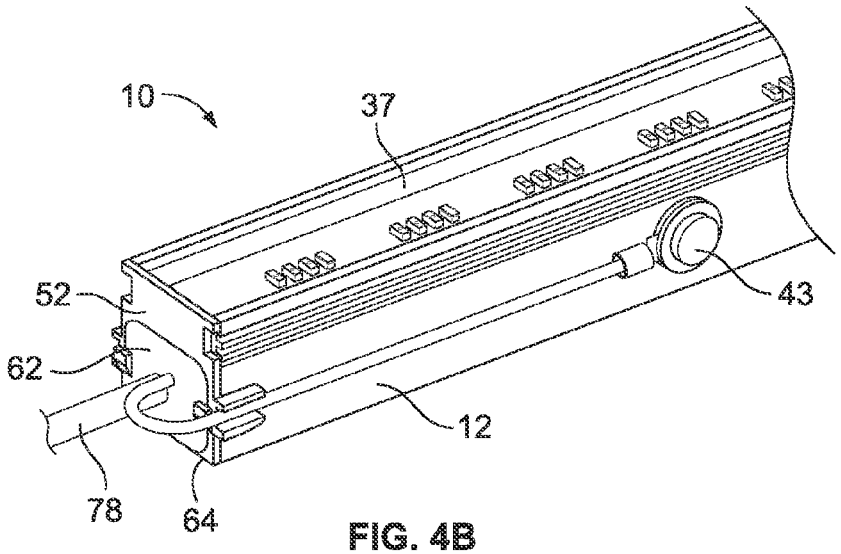
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FIG. 4B

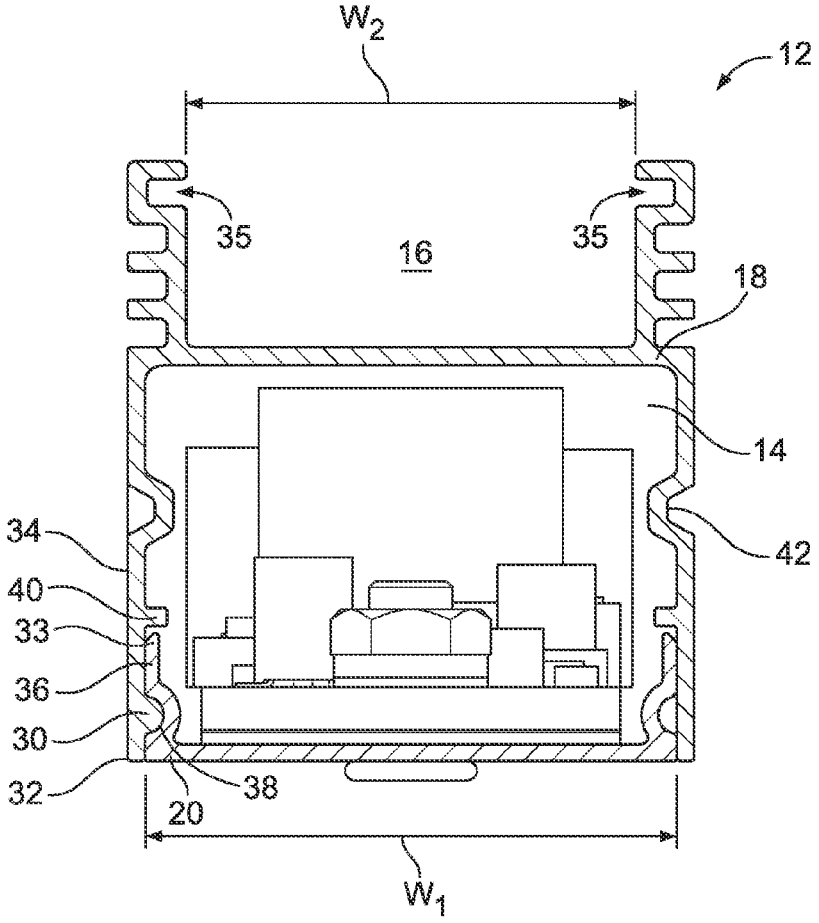
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FIG. 5

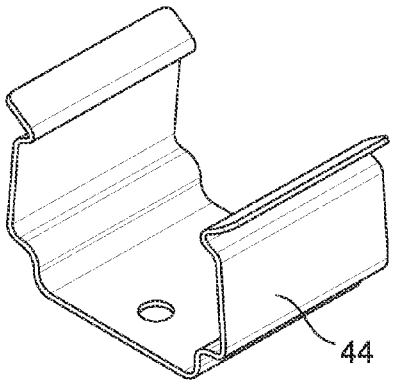

FIG. 5A

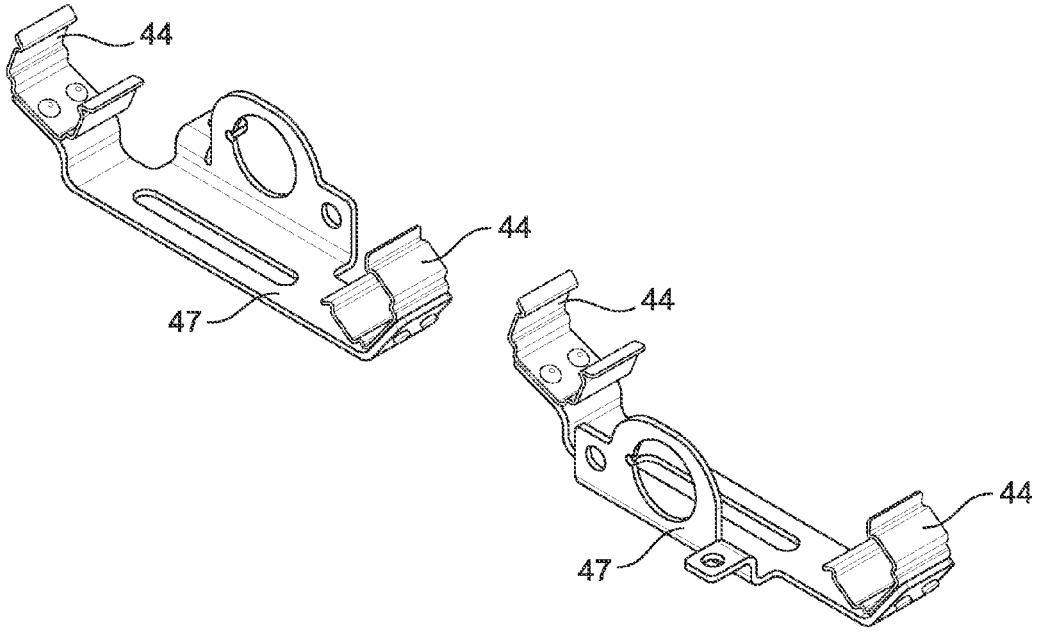

FIG. 5B

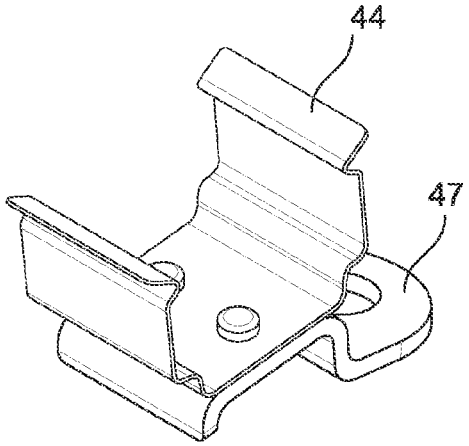

FIG. 5C

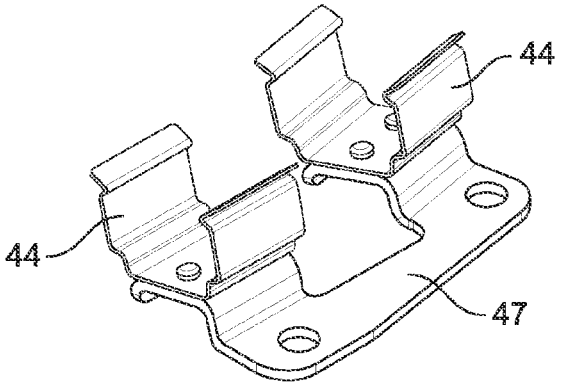

FIG. 5D

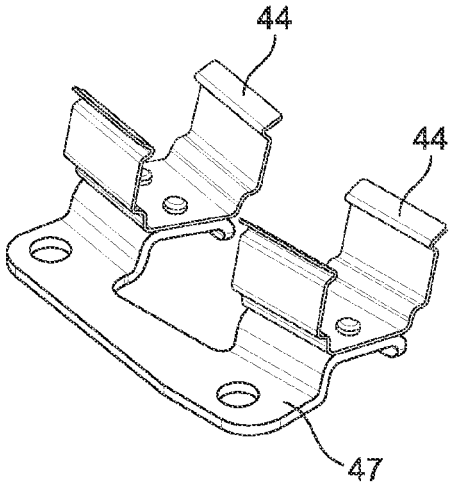

FIG. 5E

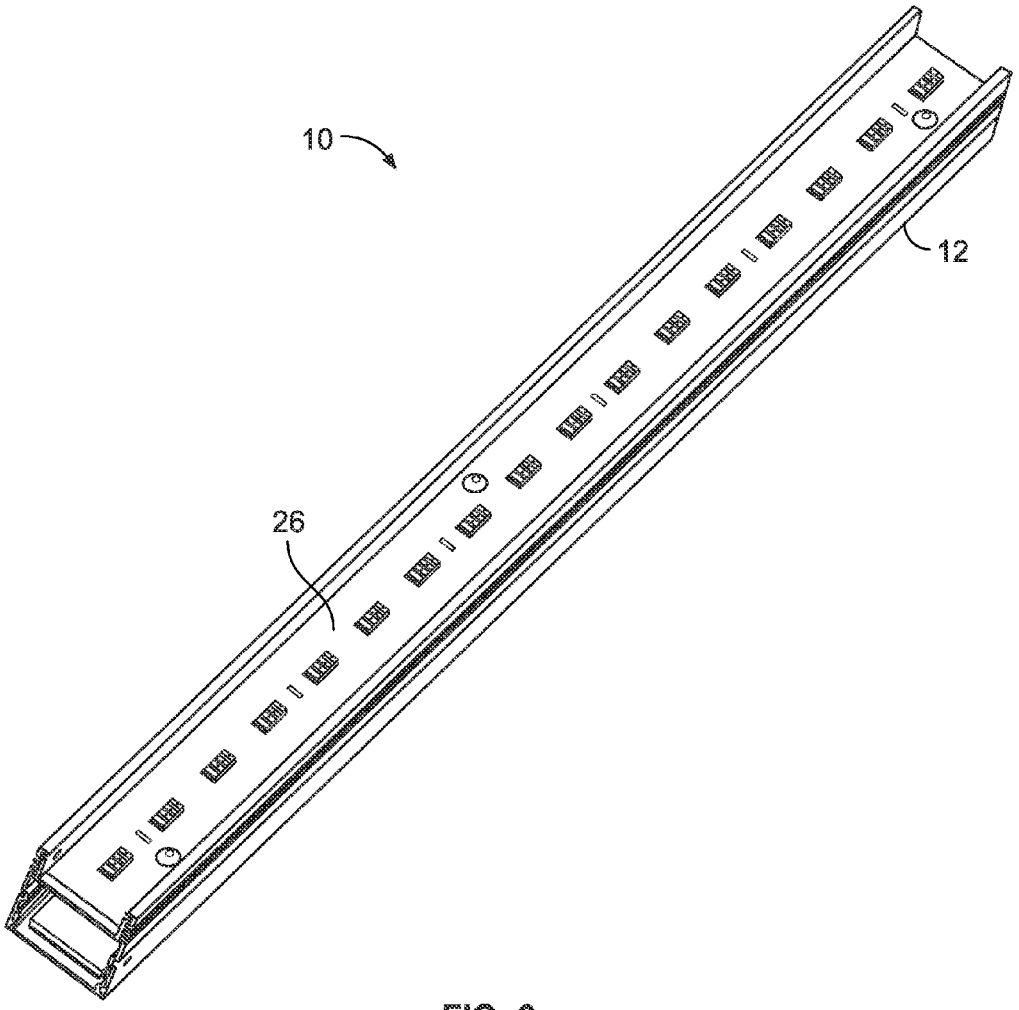

FIG. 6

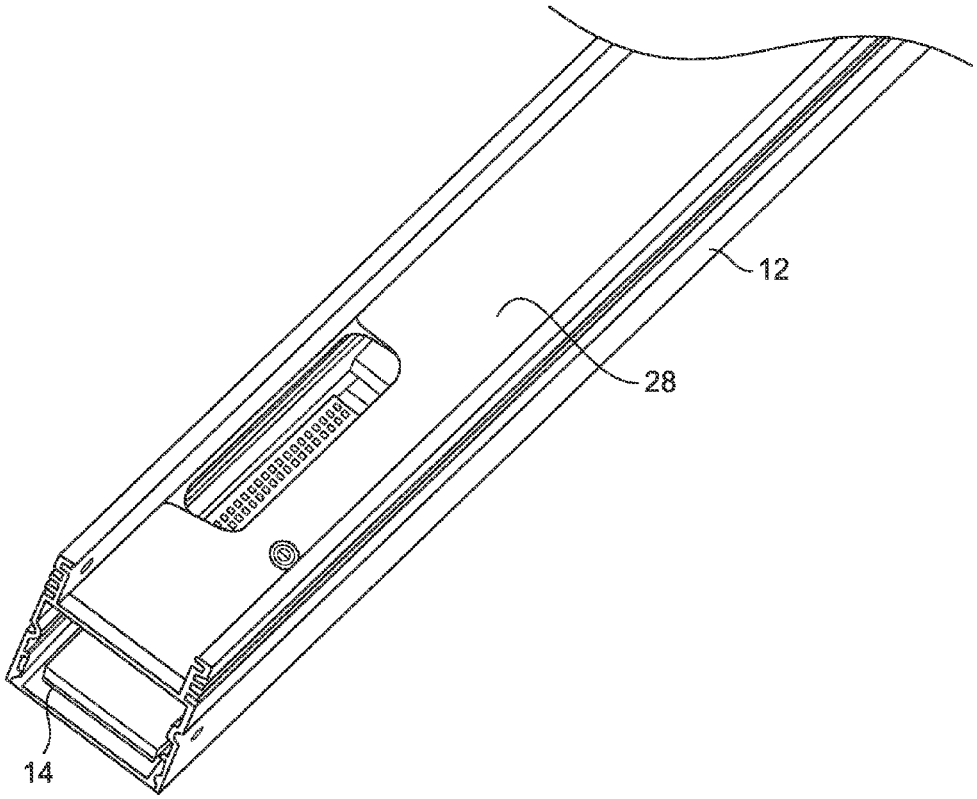

FIG. 7

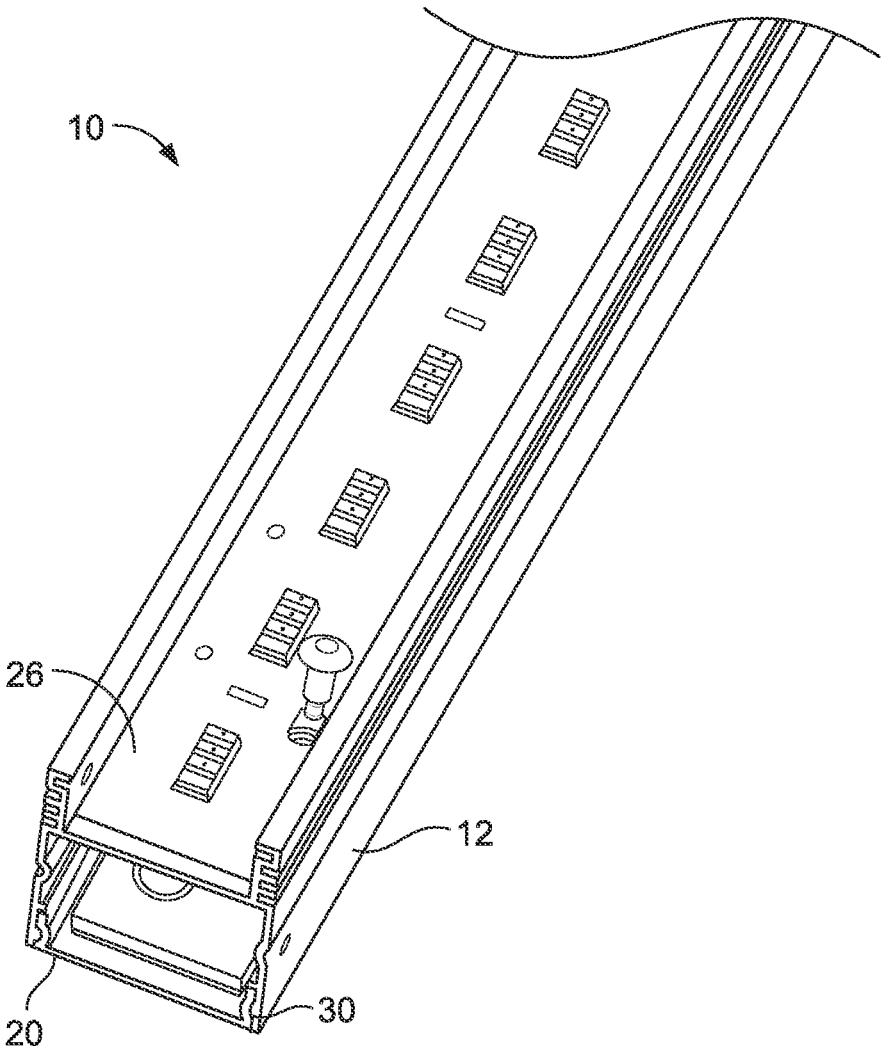

FIG. 8

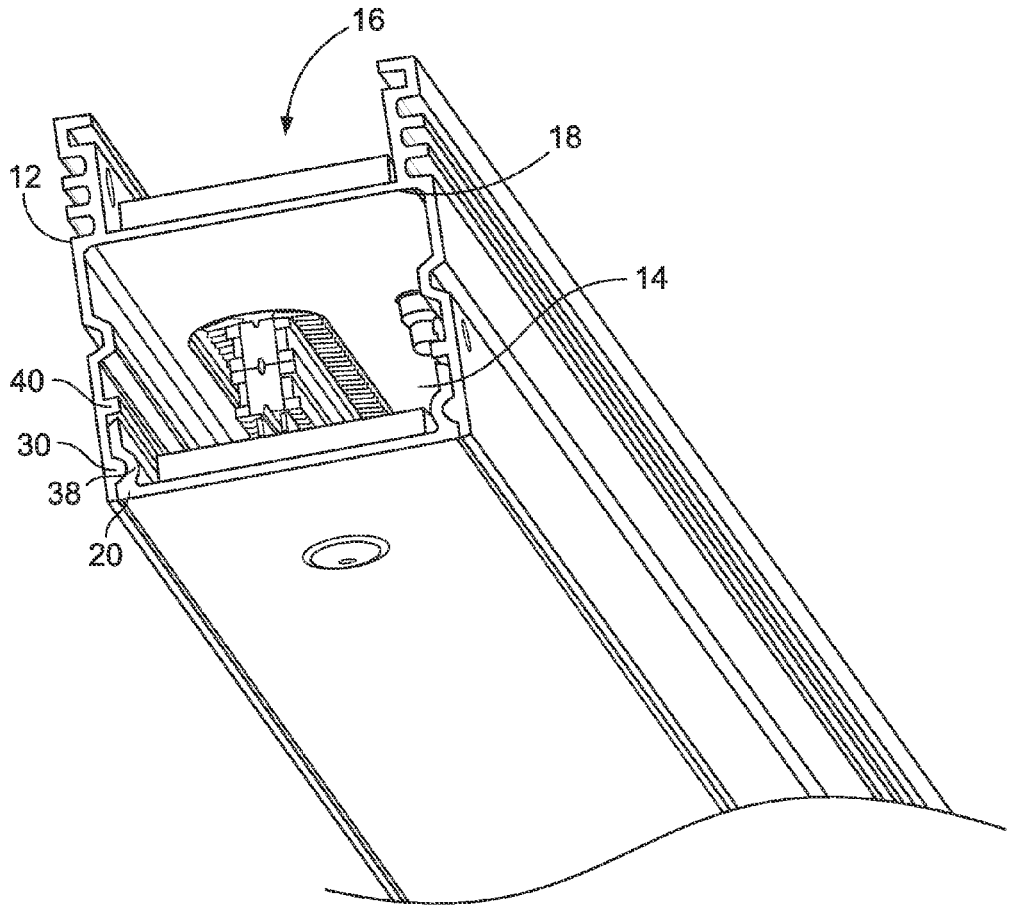

FIG. 9

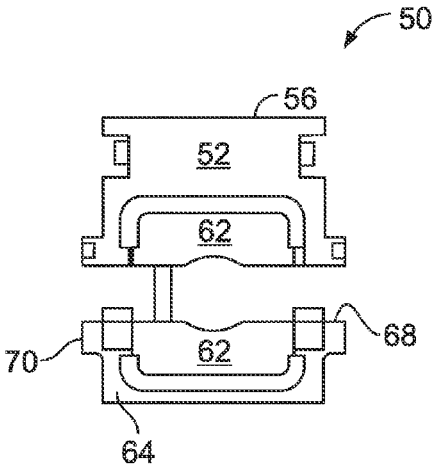

FIG. 10A

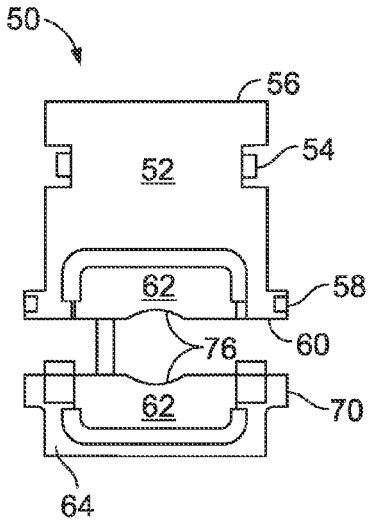

FIG. 10B

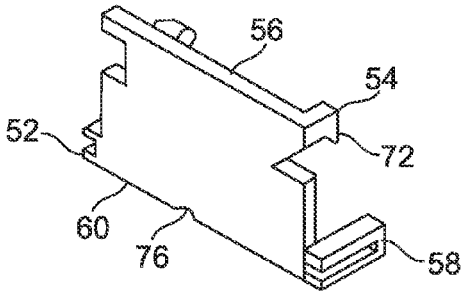

FIG. 11

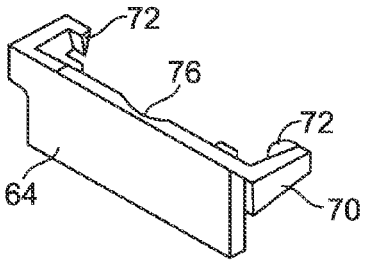

FIG. 12

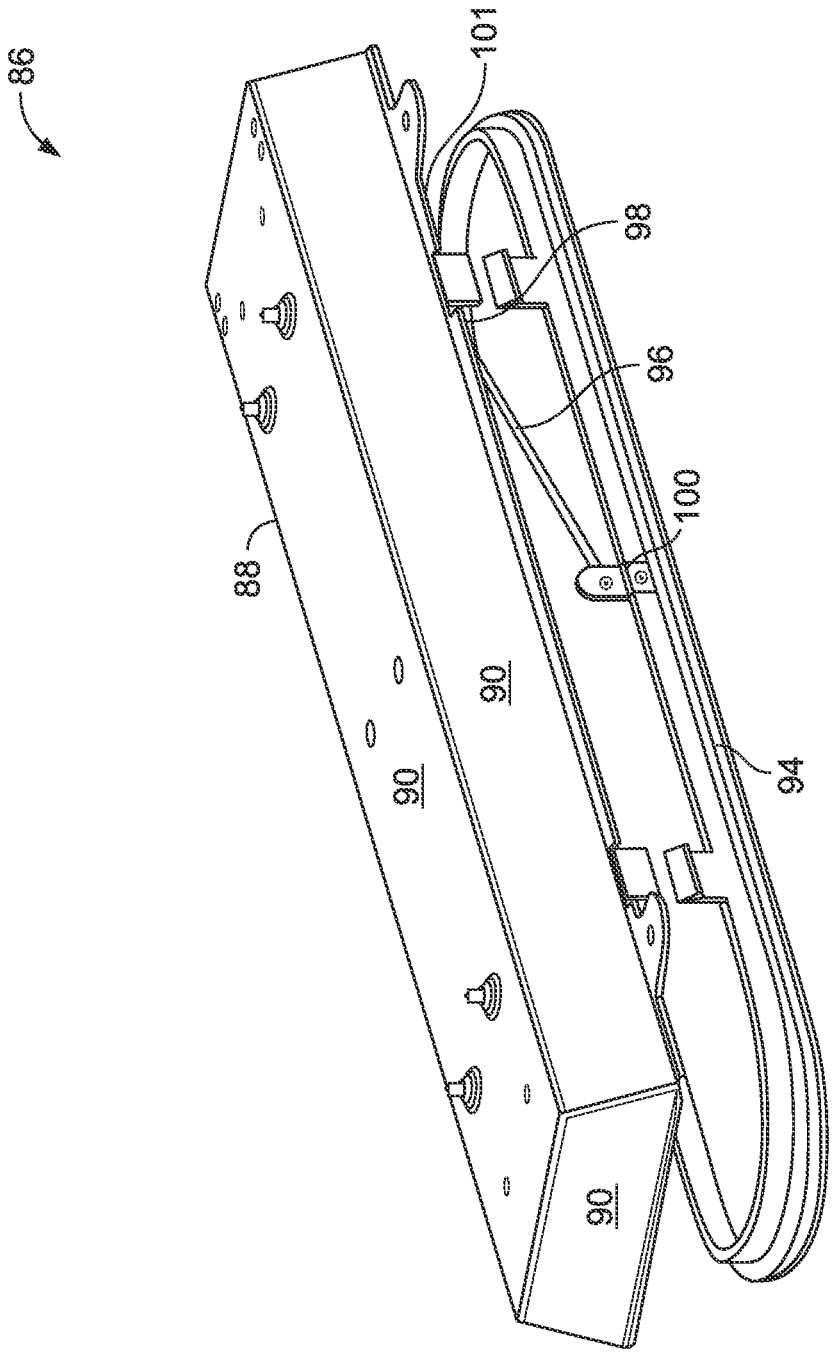

FIG. 13

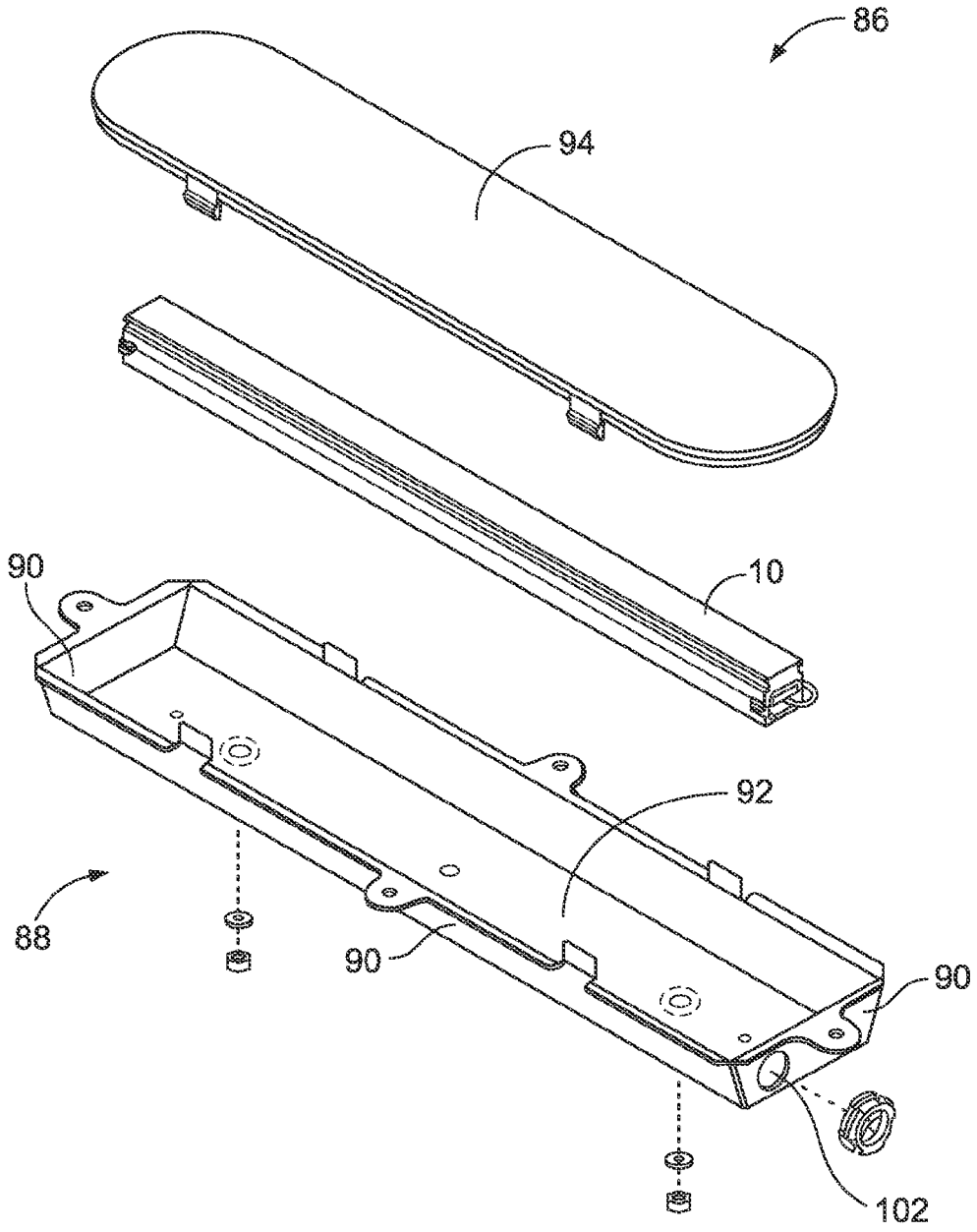

FIG. 14

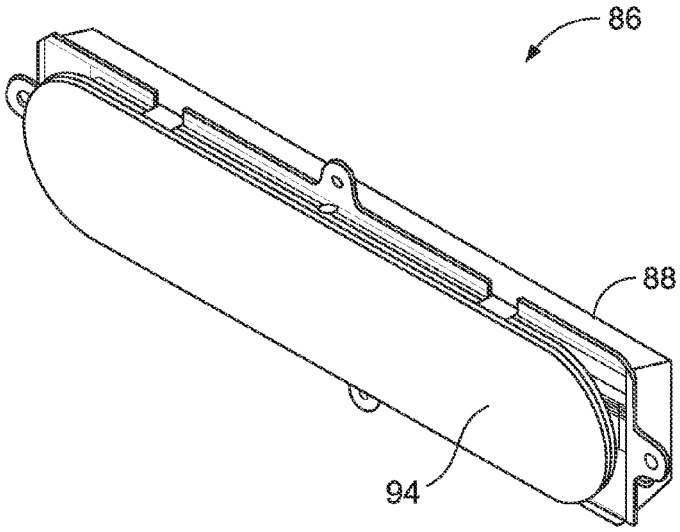

FIG. 15

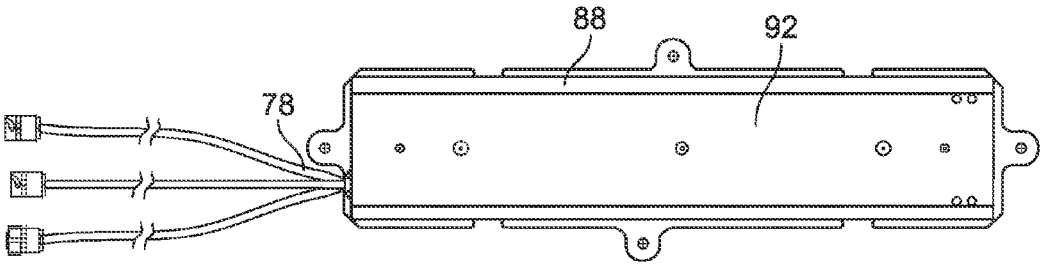

FIG. 16

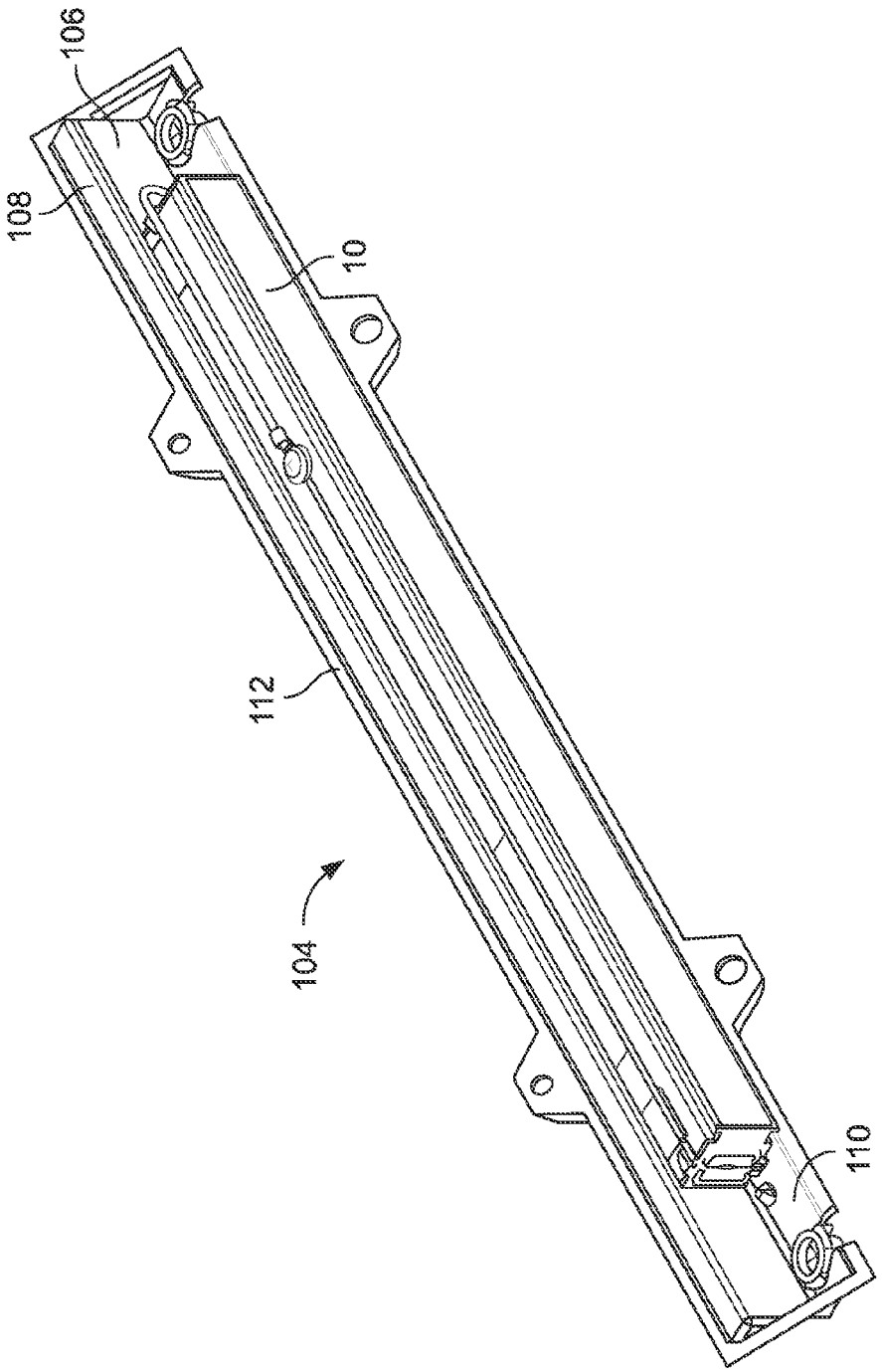

FIG. 17

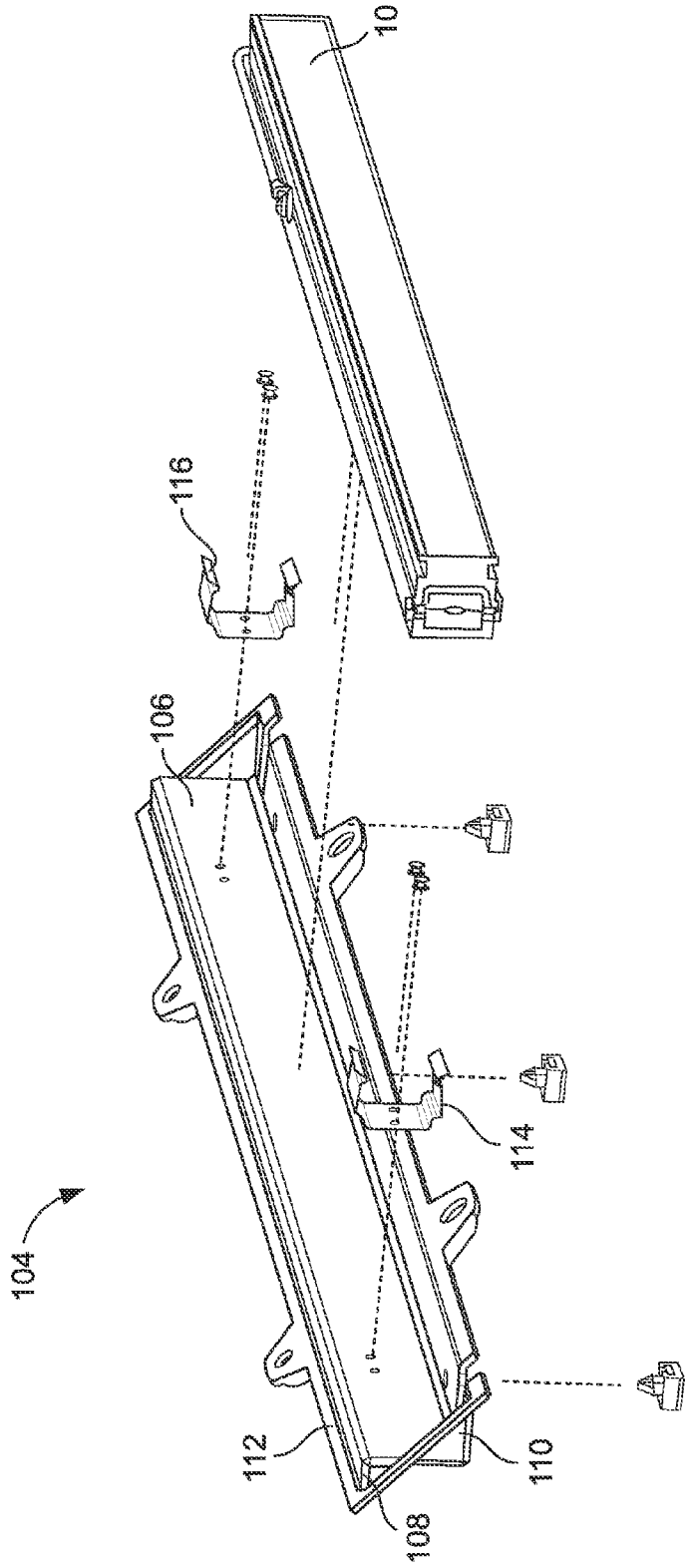

FIG. 18

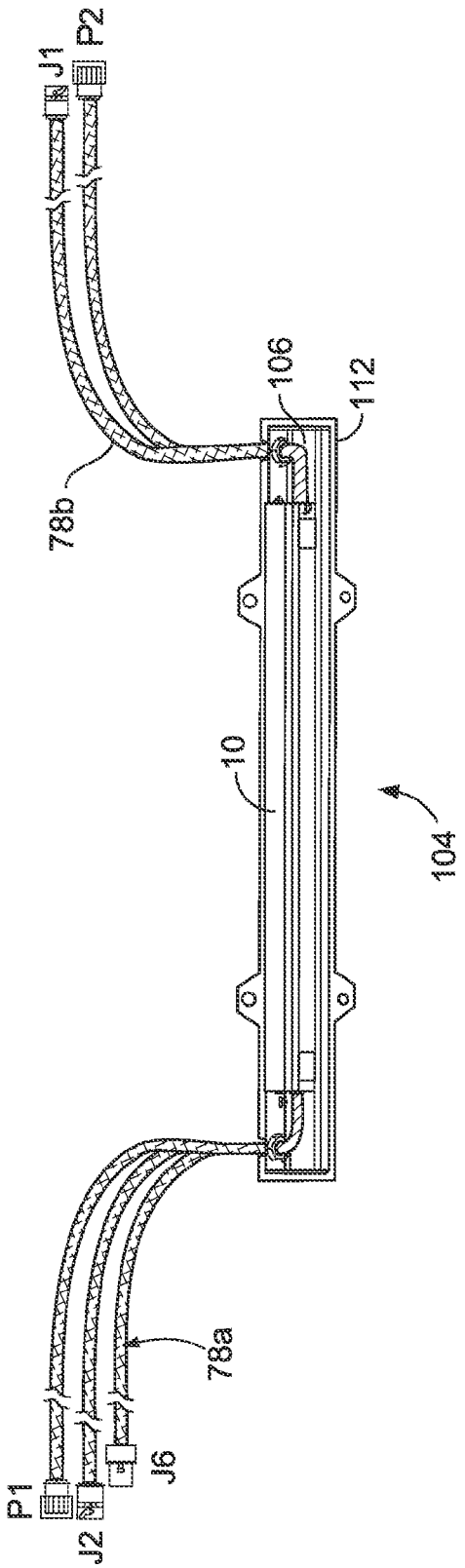

FIG. 19

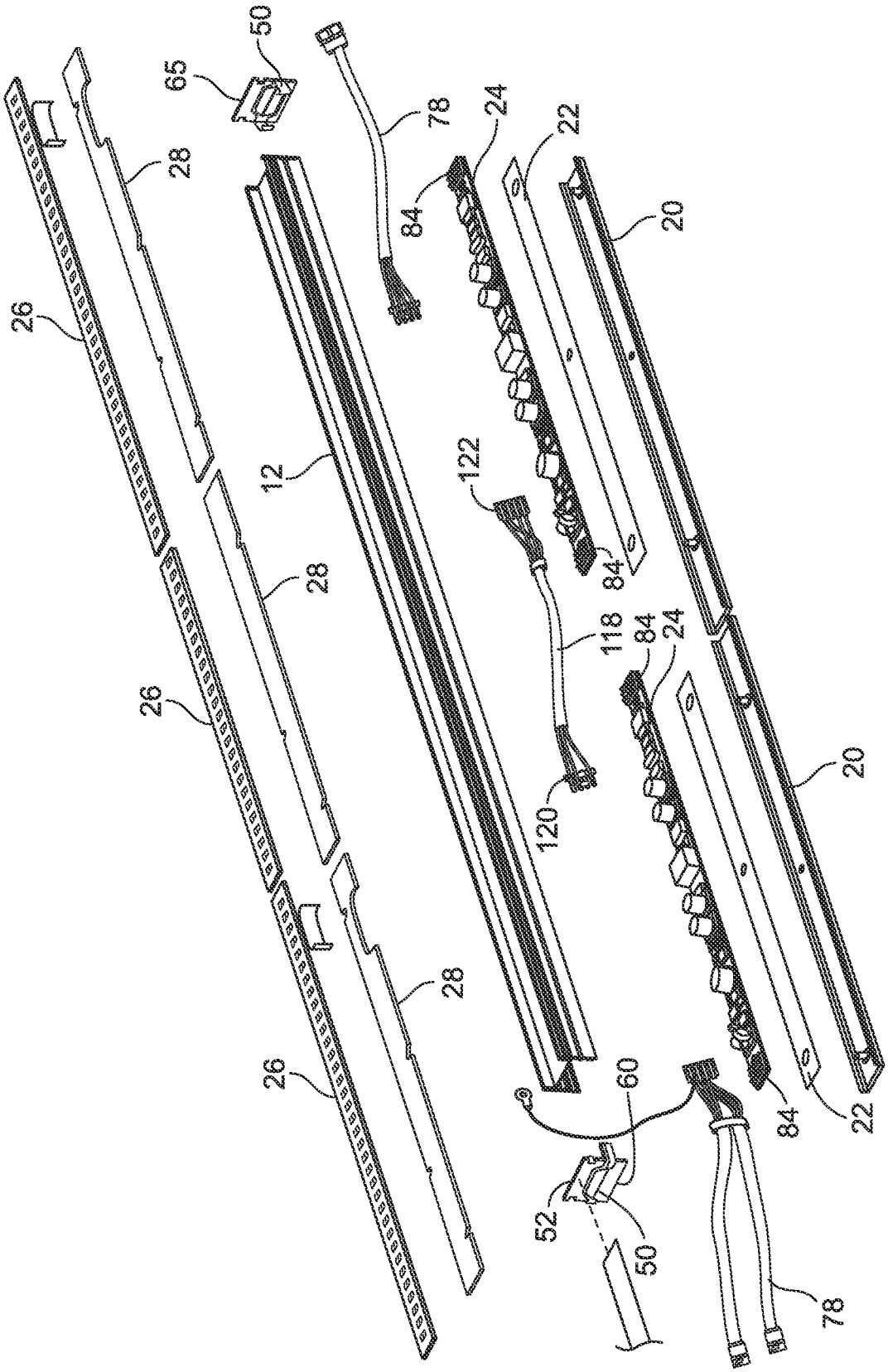
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FIG. 20

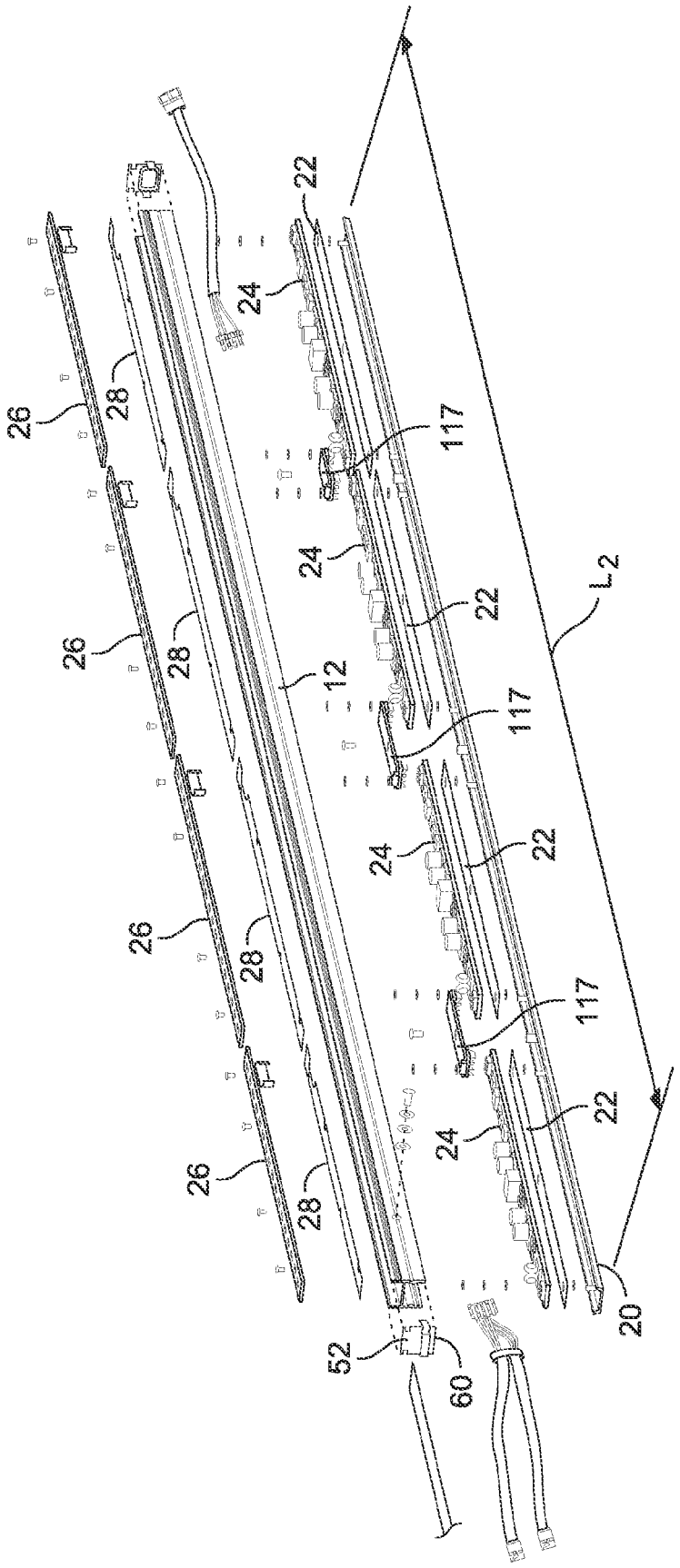

FIG. 21

LED LIGHTING ELEMENT

CROSS-REFERENCE TO RELATED PATENT APPLICATIONS

This patent application claims the benefit of U.S. Provisional Patent Application No. 61/308,171, filed Feb. 25, 2010 and U.S. Provisional Patent Application No. 61/345,378, filed May 17, 2010. The contents of both being herein incorporated by reference.

FIELD OF THE INVENTION

This invention pertains to a light housing in general and, more particular, to a housing for LED lighting elements used to illuminate the inside of a space such as a vehicle or room.

BACKGROUND OF THE INVENTION

Housings for various light sources are well known in the art. Known housings have ranged from a simple shade that covered a light source and diffused the light to a rugged, heavy-duty housing that protects and disperses the light, as necessary. Incandescent lamps have traditionally been housed in light fixtures such as a translucent bowl or lens cover that diffuses and reduces the brightness of the light. Fluorescent lights have also been encased in a translucent housing that allows the light to be inserted and removed from a desired socket.

The evolution of lighting from incandescent to fluorescent to light emitting diodes has led to the need for improved housings in which to contain the light source while at the same time providing an enclosure for a power source or an electrical connector. LED lighting elements need to be able to be mounted at various angles and, often in odd locations. Unlike the traditional light bulb that is mounted in a particular socket, LED lighting elements can be strung along or behind various surfaces with their lighting output being directed in multiple directions. Therefore, an LED lighting element that would be capable of being mounted at various angles along with multiple LED lighting elements would be an important improvement in the art.

BRIEF SUMMARY OF THE INVENTION

An LED lighting element having an H-shaped housing is disclosed. The housing, which may be an extruded housing, has a first section and a second section which is separated from the first section by a cross bar. A back plate is positioned opposite of the crossbar and is removably secured to the first section. A heat sink is located within the housing while a microcontroller and LED drive/control technology and integrated power supply contacts the heat sink and is attached to the back plate. An LED PC board that is electrically connected to the microcontroller and LED drive/control technology and integrated power supply is positioned in the second section and is attached to the housing.

An end cap for the housing is also disclosed. The end cap attaches to at least one end of the housing. The end cap comprises a first element that has a first pair of mounting legs proximal to a first end. A second pair of mounting legs is adjacent to the second end, as is a cable access portion. A second element of the end cap has a cable access portion adjacent to a first end and a pair of mounting legs perpendicular to and adjacent the first end, wherein the first and second elements are made of a first material and the cable access portion of each element is made of a second material that is more flexible than the first material.

Also disclosed in a method for constructing an LED lighting element. The method involves: (a) providing an H-shaped, housing, said housing having a first section and a second section separated by a crossbar; (b) attaching a heat sink to a first side of a back plate; (c) placing a microcontroller and LED drive/control technology and integrated power supply over the heat sink; (d) securing the back plate to the housing; (e) placing an LED PC board in the second section; and (f) electrically connecting the LED PC board to the microcontroller and LED drive/control technology and integrated power supply. In another embodiment, an end cap is attached to each of a first and second end of the housing

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective of an LED lighting element

FIG. **2** is an exploded view of an LED lighting element.

FIG. **2**(*a*) is a perspective view and various other view of electrical connectors used in conjunction with an LED lighting element.

FIG. **3** is a perspective of the back plate with the microcontroller and LED drive/control and integrated power supply PC board used in the LED lighting element.

FIG. **4** is a sectional view showing the IPS PC board mounted on the back plate.

FIG. **4**(*a*) is cut-away view showing an end view of an LED lighting element

FIG. **4**(*b*) is a perspective view of an end of a housing of an LED lighting element.

FIG. **5** is an end view of an LED lighting element with end cap removed.

FIG. **5**(*a*) is a perspective view of a mounting clamp.

FIG. **5**(*b*) is a perspective view showing mounting clamps attached to a mounting bracket in an embodiment used with an LED lighting element.

FIG. **5**(*c*) is a perspective view showing mounting clamps attached to a mounting bracket in an embodiment used with an LED lighting element.

FIG. **5** (*d*) is a perspective view showing mounting clamps attached to a mounting bracket in an embodiment used with an LED lighting element.

FIG. **5** (*e*) is a perspective view showing mounting clamps attached to a mounting bracket in an embodiment used with an LED lighting element.

FIG. **6** is a perspective showing an LED PC board in the housing of an LED lighting element.

FIG. **7** is perspective showing a thermal pad mounted in a second section of an LED lighting element.

FIG. **8** is a perspective showing an LED PC board mounted in a second section of an LED lighting element.

FIG. **9** is a perspective showing and end of an LED lighting element with end cap removed.

FIG. **10**A is view of one embodiment of an end cap assembly.

FIG. **10**B is a view of a second embodiment of an end cap assembly.

FIG. **11** is a perspective of the first element of the end cap assembly.

FIG. **12** is a perspective of the second element of the end cap assembly.

FIG. **13** is a perspective view of one embodiment of a housing for an LED lighting element

FIG. **14** is an exploded view of one embodiment of a housing for an LED lighting element.

FIG. **15** is a perspective view of one embodiment of a housing for an LED lighting element.

FIG. **16** is a bottom view of the first component of one embodiment of a housing for an LED lighting element.

FIG. **17** is a perspective view of a second embodiment of a housing for an LED lighting element.

FIG. **18** is an exploded view of a second embodiment of a housing for an LED lighting element.

FIG. **19** is a front view of a second embodiment of a housing for an LED lighting element.

FIG. **20** is a perspective view showing two microcontroller and LED drive/control technology and integrated power supplies joined by a wiring harness in a single elongated LED lighting element.

FIG. **21** is a perspective view showing two microcontroller and LED drive/control technology and integrated power supplies joined by a PC board in a single elongated LED lighting element.

DETAILED DESCRIPTION OF THE INVENTION

FIGS. **1**, **2**, **6**, **8** and **9** show an LED lighting element **10** having an H-shaped housing **12**. The housing **12**, which may be an extruded housing, has a first section **14** and a second section **16** which is separated from the first section **14** by a cross bar **18**, as shown in FIGS. **5** and **9**. A back plate **20** is positioned opposite of the crossbar **18** and is removably secured to the first section **14**, as shown in FIGS. **2**, **5** and **9**. A heat sink **22**, as shown in FIGS. **2** and **3**, is located within the housing **12** while a microcontroller and LED drive/control technology and integrated power supply **24** contacts the heat sink **22** and is attached to the back plate **20**. An LED PC board **26** that is electrically connected to the microcontroller and LED drive/control technology and integrated power supply **24** is positioned in the second section **16** and is attached to the housing **12**, as is shown in FIGS. **2**, **6** and **8**.

The H-shaped housing has a first height h_1. In a second embodiment, the housing may have a second height h_2 that is greater than h_1 so as to allow for the housing of a larger optic and to provide greater heat sinking capability.

In an embodiment, the heat sink **22** is a first thermal pad. In a more particular embodiment, as shown in FIGS. **2** and **3**, the first thermal pad is adjacent to the back plate **20** and the microcontroller and LED drive/control technology and integrated power supply **24** overlies the thermal pad. In another embodiment, a second heat sink **28** is located in the second section **16**. In a more particular version of such embodiment, the second heat sink **28** is a thermal pad that is positioned in the LED lighting element **10** between the crossbar **18** and the LED PC board **26**, as shown in FIG. **2**.

As shown in FIGS. **5**, **8**, and **9**, a protrusion **30** extends inward from the housing **12** proximal to a first end **32** of a first side **34** of the first section **14**. The back plate **20** includes a leg portion **36** that extends into the first section **14** and includes a protrusion receiving section **38**. The protrusion **30** extending inward from the housing **12** snaps into the protrusion receiving section **38**, thereby releaseably engaging the back plate **20** with the housing **14**. A second protrusion **40**, as shown in FIGS. **5** and **9**, may also extend inward from the housing **12** into the first section **14**. This second protrusion **40** limits the distance the firsts end **33** of the leg portion **36** of the back plate **20** can advance into the first section **14**. Slots **35** are used to enclose an optic **37**, as shown in FIGS. **4**(*a*) and (*b*).

In an embodiment, as shown in FIG. **5**, the first section **14** of the housing **12** has a first width W_1, the second section **16** of the housing **12** has a second width W_2, and the first width is greater than the second width. The housing **12** also has a first length L_1, as shown in FIG. **1**, a groove **42** on the outer surface may extend along the length L_1 of the housing **12**. This groove **42** is used to mount the housing **12** on a mounting clamp **44**, as shown in FIG. **5**(*a*). In one embodiment, the groove **42** is located between the crossbar **18** and the back plate **20**.

In an embodiment, as shown in FIG. **4**, a washer **46** is located between the heat sink **22** and the back plate **20**. This aluminum washer **46** may serve as the primary electrical bonding and grounding path from the microcontroller and LED drive/control technology and integrated power supply PC board **24**, to the back plate **20**. As shown in FIG. **4**(*a*), a primary electrical grounding path is established through the snap fit interface between the housing **12** and the back plate **20**. A secondary electrical grounding path is shown in FIG. **4**(*b*) and involves a grounding wire connected at a first end through a ring terminal to a screw, bolt or like **43** on the outside of the housing **12**, and at a second end to the microcontroller and LED drive/control technology and integrated power supply PC board **24** inside of the housing **12**. The connecting bolt **43** and the back plate mounting stud and hex nut **45** are made of Cadmium plated hardware to allow for grounding and the joining of dissimilar metals. Wiring bundle **78** that extends from the housing **12**, as shown in FIG. **4**(*b*), may include up to two static ground lines that each provide a static ground for an LED lighting element **10**.

In still another embodiment, the housing **12** has at least one end **48**, and an end cap **50** attaches to the at least one end **48**, as shown in FIGS. **1** and **2**. In a more particular embodiment, as shown in FIGS. **10-12**, the end cap **50** comprises a first element **52** that has a first pair of mounting legs **54** proximal to a first end **56**. A second pair of mounting legs **58** is adjacent to the second end **60**, as is a cable access portion **62**. A second element **64** of the end cap **50** has a cable access portion **62** adjacent to a first end **68** and a pair of mounting legs **70** perpendicular to and adjacent the first end **68**, wherein the first and second elements **52**, **64** are made of a first material and the cable access portion **62** of each element is made of a second material that is more flexible than the first material.

In an embodiment, the cable access portion **62** of the first element **52** is capable of separating from the cable access portion **62** of the second element **64**. In such an embodiment, connection prongs **72** extend from the end of each of the mounting legs **70**, as shown in FIGS. **2**, **11**, and **12**. These connection prongs **72** fit in respective holes **74** in the side of the housing **12**, thereby connecting the first and second element **52**, **64** of the end cap **50** to the housing **12**. The first element **52** of the end cap **50** secures the optic **37** from axial motion.

When in operation, the end cap **50** is fitted over an end of the LED lighting element **10**. The two part end cap **50** is secured to the lighting element **10** by the mounting legs **70** engaging an opening **74** in the side of the lighting element housing **12**. Once both elements **52**, **64** of the end cap **50** are secured to the housing **12**, the cable access portion **62** of each element **52**, **64** align with one another. In an embodiment, as shown in FIGS. **10-12**, a slight curvature **76** is formed in the edge of each element's cable access portion **62**. Such curvatures **76** are, preferably, aligned with each other in the center of the cable access portions **62**.

As shown in FIG. **4**B, the flexible material of the cable access portions **62** allows a wire or cable bundling **78** to extend from a connector **84** in a first LED lighting element housing **12**, through the cable access portion **62** of the end cap **50** to either a second LED lighting element housing **12** or a connector outside of the first LED lighting element housing **12**. Attached to one end of the wire or cable bundling **78** is a

connector **85**, an embodiment of which is shown in FIG. **2**A. This connector **85** connects with the connector **84** in the housing **12**. By allowing a cable or wire bundle **78** to extend through the cable access portion **62** of each end cap **50** to connect with a second LED lighting element housing **12**, a series of housings **12** can be strung together while being electrically connected to one another.

When in operation, electrical power and control signals are transmitted from an electrical power source such as a vehicle's electrical system and a master controller through the wire or cable bundling **78** to the microcontroller and LED drive/control technology and integrated power supply **24**. The microcontroller then sends pulse width modulation ("PWM") values to an LED driver chip located on the microcontroller and LED drive/control technology and integrated power supply **24**. The LED drive chip uses the PWM values to electronically control the intensity/brightness of the LEDs, thereby causing the LEDs to illuminate in a desired lighting scene.

In an embodiment, as shown in FIGS. **13-16**, the lighting element **10** is itself enclosed in a housing **86**, the housing **86** is comprised of a first component **88** having a plurality sides **90** that define a void **92** suitable for receiving the LED lighting element **10**. A lens **94** is removably attached to the first component **88**, thereby enclosing the void **92**. In a particular version of this embodiment, the lens **94** snaps together with the first component **88**. In a more particular version, the void **92** is shaped like a channel, as shown in FIG. **14**.

In another embodiment, the lens **94** is secured to the first component **88** through the use of a lanyard **96** having a first end **98** that is attached to the first component **88**, and a second end **100** that is attached to the lens **94** so as to secure the lens **94** to the first component **88**, as shown in FIG. **13**. In a more particular version of this embodiment, the first end **98** of the lanyard **96** is attached to an inner surface **101** of one of the plurality of sides **90** of the first component **88**, as shown in FIG. **13**.

In still another embodiment, one of the plurality of sides **90** of the first component **88** defines a hole **102**, as shown in FIG. **14**. In another embodiment, one of the plurality of sides **90** is rectangular, and at least two of the plurality of sides **90** are trapezoids, with each of the two trapezoidal sides being opposite one another, as shown in FIGS. **13** and **15**. In a more particular version of this embodiment, at least one of the two trapezoidal sides **90** defines a hole **102**. In a more particular version of this embodiment, the first component **88** has five sides **90**.

In an embodiment, the lens **94** is in the shape of oval, as shown in FIGS. **13-15**. The lens **94** may also have a smooth outer surface. A wiring bundle **78** may also extend through the hole **102**.

When in operation, the LED lighting element **10** is positioned in the first component **88** of the housing **86** through the use of screws, bolts, or the like. The first component **88** of the housing **86** is then secured to a mounting surface such as an aircraft cabin bulkhead. In an embodiment, the housing **86** may be secured to an aircraft cabin bulkhead through the use of screws or the like inserted in holes in the mounting flanges that are on the first component **88**, as shown in FIGS. **13-16**. The lens **94** is then secured to the first component **88** by any suitable means including being snapped into place.

In still another embodiment, the lighting element **10** is itself attached to a housing **104** that is comprised of a lighting-element mounting portion **106** that has a first surface **108** that extends approximately 90° from the lighting-element mounting portion **106**, and a second surface **110** that extends approximately 90° from the lighting-element mounting portion **106** opposite the first surface **108**, as shown in FIG. **17**. A cabin mounting bracket **112** surrounds the lighting-element mounting portion **106**. In an embodiment, the cabin mounting bracket **112** is angled approximately 45° with respect to the lighting-element mounting portion **106**.

As shown in FIG. **17**, the LED lighting element **10** may be mounted flush to the lighting-element mounting portion **106**. In another embodiment, a first **114** and a second **116** mounting clamp are attached to the lighting-element mounting portion **106**, and the LED lighting element **10** is attached to the mounting clamps **114**, **116**, as shown in FIG. **18**.

In another embodiment, a first and a second wiring bundle **78**(*a*) and **78**(*b*) extend from the housing **104**, as shown in FIG. **19**. In a particular version of this embodiment, the second wiring bundle **78**(*b*) is connected to a main power source (not shown), and the first wiring bundle **78**(*a*) is connected to an emergency power source (not shown).

When in operation, the LED lighting element **10** is mounted on the lighting-element mounting portion **106**, of the housing **104**. In a particular version of this embodiment, mounting clamps are **114** and **116** are attached to the mounting portion **106**. The LED lighting element is then pressed into the mounting clamps **114** and **116** until the edge of each clamp engages the groove **42** that extends along the housing **12** of the lighting element **10**. The housing **104** is then secured to a mounting surface such as a vehicle bulkhead through the use of screws or the like inserted in the holes in the mounting flanges on the cabin mounting bracket **112**.

A method for constructing an LED lighting element **10** is also disclosed. The method involves: (a) providing an H-shaped, housing **12**, said housing **12** having a first section **14** and a second section **16** separated by a crossbar **18**; (b) attaching a heat sink **22** to a first side of a back plate **20**; (c) placing a microcontroller and LED drive/control technology and integrated power supply **24** over the heat sink **22**; (d) securing the back plate **20** to the housing **12**; (e) placing an LED PC board **26** in the second section **16**; and (f) electrically connecting the LED PC board **26** to the microcontroller and LED drive/control technology and integrated power supply **24**. In another embodiment, an end cap **50** is attached to each of a first **48** and second end **49** of the housing **12**.

In another embodiment, the microcontroller and LED drive/control technology and integrated power supply **24** has a first end **80** and a second end **82**, and an electrical connector **84** is attached to the microcontroller and LED drive/control technology and integrated power supply **24** adjacent to at least one of the first **80** and second **82** end. In a more particular version of the embodiment, a wiring bundle **78** is electrically connected to the electrical connector **84**, as shown in FIGS. **2** and **2**(*a*). The wiring bundle **78** then extends outward from the housing **12**. Electrical connector **84** and wiring bundle **78** mating interface **85** provides wire bundle strain relief as well as providing the ability to allow the use of different connector **200** variations or types.

In another embodiment, as shown in FIG. **20**, a wiring harness **118** has as first end **120** connected to the electrical connector **84**; and a second end **122** connected to a second electrical connector **84** on a second microcontroller and LED drive/control technology and integrated power supply **24**.

In still another embodiment of the method, the H-shaped housing **12** has a first side and a second side, and a groove **42** is scored along each of the first and second sides. A mounting clamp **44** is then fitted into the groove **42** along each of the first and second sides. The mounting clamp **44** is capable of being attached to various types of bracket geometries, as

shown in FIGS. **5**B-D. End cap legs **58** and **70** act as stops such that the housing does not axially slide out of the mounting clamps **44**.

In another embodiment the housing **12** has a second length L_2 that is greater than the first length L_1. This longer housing length L_2 can accommodated the utilization of several microcontroller and LED drive/control technology and integrated power supplies **24** connected together by interconnected PC boards **117**, as shown FIG. **21**, or interconnected wire harnesses **118**, as shown in FIG. **20**.

All references, including publications, patent applications, and patents, cited herein are hereby incorporated by reference to the same extent as if each reference were individually and specifically indicated to be incorporated by reference and were set forth in its entirety herein.

The use of the terms "a" and "an" and "the" and similar referents in the context of describing the invention (especially in the context of the following claims) are to be construed to cover both the singular and the plural, unless otherwise indicated herein or clearly contradicted by context. Recitation of ranges of values herein are merely intended to serve as a shorthand method of referring individually to each separate value falling within the range, unless otherwise indicated herein, and each separate value is incorporated into the specification as if it were individually recited herein. All methods described herein can be performed in any suitable order unless otherwise indicated herein or otherwise clearly contradicted by context. The use of any and all examples, or exemplary language (e.g., "such as") provided herein, is intended merely to better illuminate the invention and does not pose a limitation on the scope of the invention unless otherwise claimed. No language in the specification should be construed as indicating any non-claimed element as essential to the practice of the invention.

Preferred embodiments of this invention are described herein, including the best mode known to the inventors for carrying out the invention. It should be understood that the illustrated embodiments are exemplary only, and should not be taken as limiting the scope of the invention.

What is claimed is:

1. An LED lighting element comprising:
- an H-shaped housing, said housing having a first section and a second section separated from the first section by a crossbar;
- a back plate opposite the crossbar, said back plate removably secured to the first section;
- a heat sink located within the housing;
- lighting element circuitry comprising a microcontroller and LED drive/control technology and integrated power supply contacting the heat sink, the lighting element circuitry being attached to the back plate; and
- an LED PC board positioned in the second section and attached to the housing, said PC board electrically connected to the microcontroller and LED drive/control technology and integrated power supply;
- wherein a securing of the back plate to the first section does not increase an overall height of the LED lighting element including the H-shaped housing.

2. The LED lighting element of claim **1**, wherein the heat sink is a first thermal pad.

3. The LED lighting element of claim **2**, wherein the first thermal pad is adjacent to the back plate.

4. The LED lighting element of claim **1** further comprising a second heat sink located in the second section.

5. The LED lighting element of claim **4**, wherein the second heat sink is a second thermal pad positioned between the crossbar and the LED PC board.

6. The LED lighting element of claim **1**, wherein:
- a protrusion extends inward from the housing proximal to a first end of a first side of the first section;
- the back plate includes a leg portion, said leg portions extending into the first section and defining a protrusion receiving section; and
- the protrusion snaps into the protrusion receiving section, thereby engaging the back plate with the housing.

7. The LED lighting element of claim **6**, wherein:
- a second protrusion extends inward from the housing into the first section; and
- said second protrusion limits a distance a first end of the leg portion of the back plate can advance into the first section.

8. The LED lighting element of claim **1**, wherein:
- the first section of the housing has a first width;
- the second section of the housing has a second width; and
- the first width is greater than the second width.

9. The LED lighting element of claim **1**, wherein:
- the housing has a first length; and
- the housing has an outer surface that defines a first groove that extends along the length of the housing.

10. The LED lighting element of claim **1**, wherein the first groove is located between the crossbar and the back plate.

11. The LED lighting element of claim **1** further comprising an electrically conductive washer located between the heat sink and the back plate that serves as a primary electrical bonding and grounding path from the lighting element circuitry to the back plate.

12. An LED lighting element comprising:
- an H-shaped housing, said housing having a first section and a second section separated from the first section by a crossbar;
- a back plate opposite the crossbar, said back plate removably secured to the first section;
- a heat sink located within the housing;
- lighting element circuitry comprising a microcontroller and LED drive/control technology and integrated power supply contacting the heat sink; and
- an LED PC board positioned in the second section and attached to the housing, said PC board electrically connected to the microcontroller and LED drive/control technology and integrated power supply;

wherein:
- the housing has at least one end;
- an end cap attaches to the at least one end of the housing, the end cap comprised of:
  - a first element having:
    - a first pair of mounting legs proximal to a first end;
    - a second pair of mounting legs adjacent to the second end; and
    - a cable access portion adjacent the second end;
  - a second element having:
    - a cable access portion adjacent a first end;
    - a pair of mounting legs perpendicular to and adjacent the first end,
  - wherein the first and second elements are made of a first material and the cable access portion of each element is made of a second material that is more flexible than the first material and covers a majority of the cable access portion.

13. The LED lighting element of claim **12**, wherein the cable access portion of the first element is capable of separating from the cable access portion of the second element.

14. The LED lighting element of claim **12**, wherein:
- connection prongs extend from the an end of each of the mounting legs; and

the connection prongs fit in respective holes in the side of the housing,

thereby connecting the first and second element of the end cap to the housing.

15. An LED lighting assembly, comprising:

an LED lighting element comprising:

an H-shaped housing, said housing having a first section and a second section separated from the first section by a crossbar;

a back plate opposite the crossbar, said back plate removably secured to the first section;

a heat sink located within the housing;

lighting element circuitry comprising a microcontroller and LED drive/control technology and integrated power supply contacting the heat sink; and

an LED PC board positioned in the second section and attached to the housing, said PC board electrically connected to the microcontroller and LED drive/control technology and integrated power supply;

an assembly housing that encloses the LED lighting element, the LED lighting element being attached to the assembly housing, the assembly housing comprising:

a first component having a plurality of sides defining a void that receives the LED lighting element; and

a lens removably attached to the first component, thereby enclosing the void.

16. The LED lighting assembly of claim **15**,

wherein the lens snaps together with the first component.

17. The LED lighting assembly of claim **15**, wherein the void is a channel.

18. The LED lighting assembly of claim **15**, wherein:

a lanyard has a first end attached to the first component; and

a second end of the lanyard is attached to the lens so as to secure the lens to the first component.

19. The LED lighting assembly of claim **18**, wherein the first end of the lanyard is attached to an inner surface of one of the plurality of sides of the first component.

20. The LED lighting assembly of claim **15**, wherein one of the plurality of sides defines a hole.

21. The LED lighting assembly of claim **15**, wherein:

one of the plurality of sides is rectangular; and

at least two of the plurality of sides are trapezoids, each of the two trapezoidal sides being opposite one another.

22. The LED lighting assembly of claim **21**, wherein at least one of the two trapezoidal sides defines a hole.

23. The LED lighting assembly of claim **21**, wherein the wiring bundle extends through the void.

24. The LED lighting assembly of claim **15**, the lens is in the shape of oval.

25. The LED lighting assembly of claim **15**, wherein the lens has a smooth outer surface.

26. The LED lighting assembly of claim **15**, wherein the plurality of sides equals five.

27. The LED lighting assembly of claim **15**, further comprising:

a mounting clamp that attaches the lighting element to the assembly housing;

wherein:

the H-shaped housing has a first side and a second side that is opposite the first side;

two grooves are scored along the opposite first and second sides; and

the mounting clamp fits into each of the two grooves for mounting the lighting element.

28. The LED lighting assembly of claim **15**, further comprising:

a mounting bracket comprising:

attachment elements for attaching the mounting bracket to an external element; and

a first mounting clamp and a second mounting clamp shaped with mating surfaces to the H-shaped housing that are attached to a portion of the mounting bracket at predefined angles.

29. An LED lighting assembly, comprising:

an assembly housing; and

an LED lighting element comprising:

an H-shaped housing, said housing having a first section and a second section separated from the first section by a crossbar;

a back plate opposite the crossbar, said back plate removably secured to the first section;

a heat sink located within the housing;

lighting element circuitry comprising a microcontroller and LED drive/control technology and integrated power supply contacting the heat sink; and

an LED PC board positioned in the second section and attached to the housing, said PC board electrically connected to the microcontroller and LED drive/control technology and integrated power supply;

wherein the lighting element is attached to the assembly housing,

wherein:

the assembly housing comprises:

a lighting-element mounting portion, said lighting-element mounting portion having a first surface extending approximately 90° from the lighting-element mounting portion, and a second surface extending approximately 90° from the lighting-element mounting portion opposite the first end; and

a cabin mounting bracket surrounding the lighting-element mounting portion, the cabin mounting bracket having a mounting surface angled approximately 45° with respect to the lighting-element mounting portion, the cabin mounting having a triangular cross-section shape, and a surface of the LED lighting element containing the LEDs being parallel to one of the triangle sides.

30. The LED lighting assembly of claim **29**, wherein the LED lighting element is mounted flush to a first surface of the lighting-element mounting bracket.

31. The LED lighting assembly of claim **30**, wherein:

a first mounting clamp and a second mounting clamp is attached to the first surface of the lighting-element mounting bracket; and

the LED lighting element is attached to the first and second mounting clamps.

32. The LED lighting assembly of claim **29**, wherein a first and a second wiring bundle extend from the housing.

33. The LED lighting assembly of claim **32**, wherein:

the first wiring bundle is connected to a main power source; and

the second wiring bundle is connected to an emergency power source.

* * * * *